BHP

Steel and iron ore market outlook / Steel debarbonisation pathways

Presentation & Speech

3 October 2022

A great many things will change over the next 30 years in commodity value chains.

The unfolding of the decarbonisation giga-trend, and the mega-trends that sit beneath it, will bring radical change in their wake.

The evolution of China's underlying demand for resources will be a second highly influential force.

The rapid expected increase in Indian and south-east Asian demand will also leave an indelible imprint on commodity markets – as will developments in the rest of the populous and ambitious emerging world.

Dealing with the impacts of physical climate change will also matter – as will the replacement of long-life capital in high income countries.

The steel value chain will be at the centre of each of these developments – and it will undergo considerable change itself:

- in technology,
- in demand and supply centres,
- in power sources, in metallic mix, and in its emissions profile.

But versus the completely revolutionary change we foresee in some areas of the energy and industrial system, it is likely that change in the steel value chain will feel more evolutionary than revolutionary, for at least two decades, and probably for longer in the emerging world.

My remarks will progress as follows:

- I will give a brief overview of where the steel value chain fits within the context of national and global economic development.
- That will then flow into a view of the outlook for steel.
- I will then discuss the iron ore market.

I will argue that the key medium-term beliefs that the iron ore industry and the wider eco-system held four years ago were all incorrect; and that an understanding of how we got to today's surprising starting point is vital to comprehend what is potentially to come.

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Unless specified otherwise: operations includes operated assets and non-operated assets; total operations refers to the combination of continuing and discontinued operations; continuing operations refers to data presented excluding the impacts of Onshore US from the 2017 financial year onwards and excluding Petroleum from the 2021 financial year onwards; references to Underlying EBITDA margin exclude third party trading activities; data from subsidiaries are shown on a 100 per cent basis and data from equity accounted investments and other operations is presented, with the exception of net operating assets, reflecting BHP's share; medium term refers to our five year plan. Numbers presented may not add up precisely to the totals provided due to rounding. All footnote content (except in the Annexures) is contained on slide 27.

Non-IFRS information

We use various Non-IFRS information to reflect our underlying performance. For further information please refer to Non-IFRS financial information set out in section 11 of the Operating and Financial Review in the Appendix 4E for the year ended 30 June 2022.

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BHP also holds interests in assets that are owned as a joint venture[1] but not operated by BHP (referred to in this release as 'non-operated joint ventures' or 'non-operated assets'). Notwithstanding that this release may include production, financial and other information from non-operated assets, non-operated assets are not included in the BHP Group and, as a result, statements regarding our operations, assets and values apply only to our operated assets unless stated otherwise.

1. References in this release to a 'joint venture' are used for convenience to collectively describe assets that are not wholly owned by BHP. Such references are not intended to characterise the legal relationship between the owners of the asset..

Portfolio positively leveraged to megatrends

Low cost assets and world class resource base across a differentiated set of commodities

BHP Portfolio	Population growth	Urbanisation	Rising living standards	Decarbonising power	Electrifying transport	Geopolitical risk	30/30 year growth BHP 1.5°C scenario
Copper Largest endowment[1]	+	++	+++	+++	+++	~	>2x
Nickel Second largest sulphide resource[2]	+	++	+++	+	++++	+	~4x
Steel Lowest cost iron ore[3] Leading met coal supplier	+	+++	++	++	~	~	~2x
Potash Large-scale resource supports up to 100 years of operation[4]	+++	+	+	~	~	+++	>2x
2050 estimate, change from current	~10 bn total population; + 2¼ bn	~7 bn urban population; + 2¾ bn	~$400 tn world GDP; 4-fold gain	¾ of power capacity wind & solar; 13-fold energy gain[5]	~2 bn EVs on the road; 100-fold gain	-	

+ Indicators are versus a baseline that does not include the theme being assessed. ~ Signifies trivial direct impact or offsetting forces that are basically in balance.

Western Australia Iron Ore site tour
3 October 2022

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BHP

The secular fundamentals of population growth, urbanisation and rising living standards will continue to underpin demand for resources, including steel, for decades to come. The decarbonisation giga-trend will also require a vast mobilization of metal supply.

Yes, that is the second time I have said “giga-trend”. Decarbonising our society is that consequential. If I can use some corporate terminology to explain this, to qualify as a giga-trend, you need to have mega-trends reporting to you.

The decarbonisation of power and the electrification of transport are megatrends in their own right, but they “report” to the wider societal objective.

The link between the end-use of mining products and decarbonisation is usually raised in the context of critical minerals like copper and nickel.

Less well understood is the fact that the demand for steel is also generally higher under Paris-aligned scenarios than in cases associated with higher degrees of global warming.

For example, in BHP’s 1.5 degree scenario, the demand for steel is indeed slightly higher than under the base case.

In broad brush strokes, our base case sees the growth in annual steel demand essentially keeping pace with population growth out to 2050: a CAGR of roughly three-quarters of a percentage point.

Cumulative demand on a 30 year over 30 year basis is expected to almost double between now and mid-century.

You will see multiple references to the 30/30 metric throughout the presentation.

It measures cumulative change in blocks that are three decades long: the 30 years to 2050 versus the 30 years prior to the pandemic.

To be clear, these are not annual run rates. Run rates, I feel, underestimate the amount of effort and capital that needs to be deployed for a massive commodity business to just stand still, let alone grow.

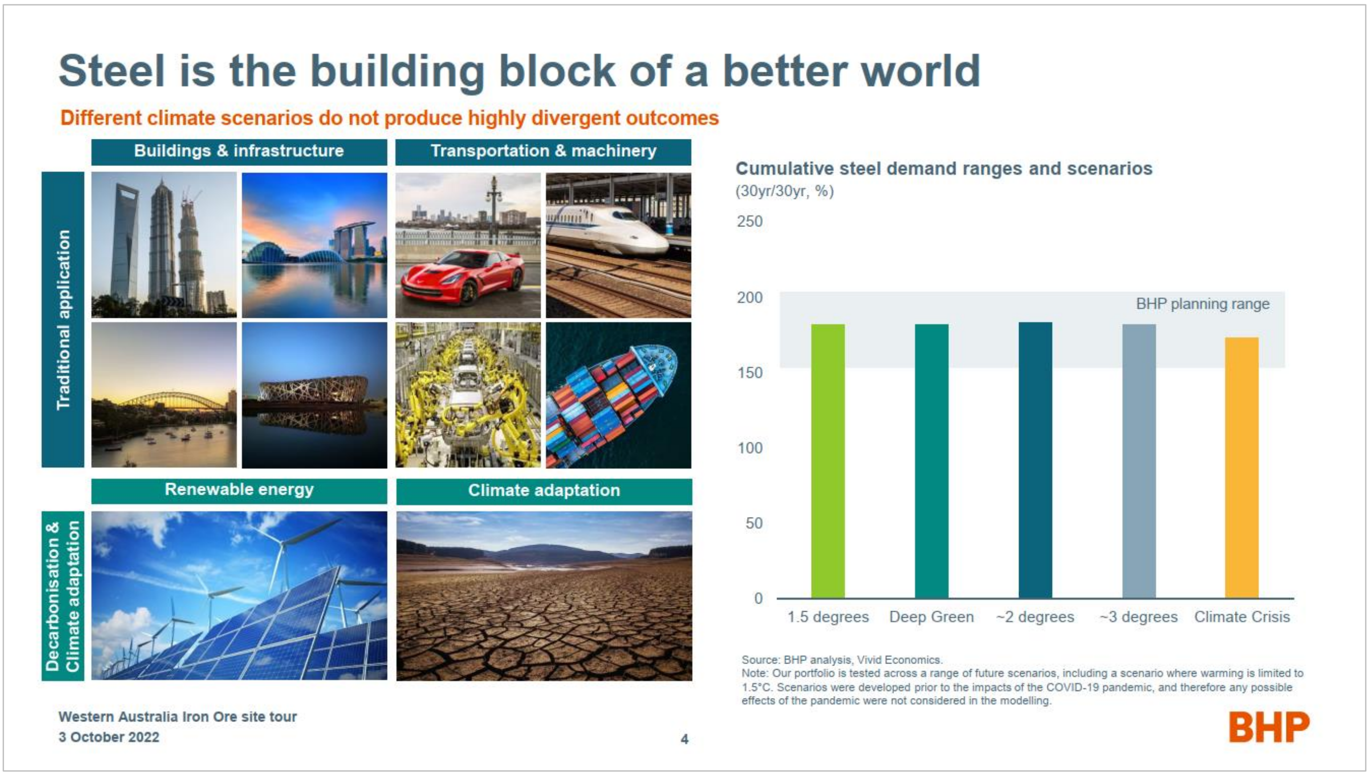
You can usefully think of the 30/30 metric as a comparison of the area underneath the curve that the annual run rates create.

And in addition to our planning ranges, which capture the various BAU cases we run to assess demand, supply and price uncertainty in our internal protocols, you will also see data from 5 of the bespoke scenarios that we use to complement, critique and strengthen our planning ranges.

Portfolio positively leveraged to megatrends (continued)

They are:

- our official BHP 1.5 degree case, which is now incorporated into central planning deliberations, as flagged in the Climate Transition Action Plan (CTAP),
- the disruptive “Climate Crisis” scenario that we first discussed in our Climate Change Report,
- the “Deep Green” hypothetical that also featured heavily in our CTAP, and
- two scenarios that map to specific, rounded global warming outcomes of 2 and 3 degrees respectively.



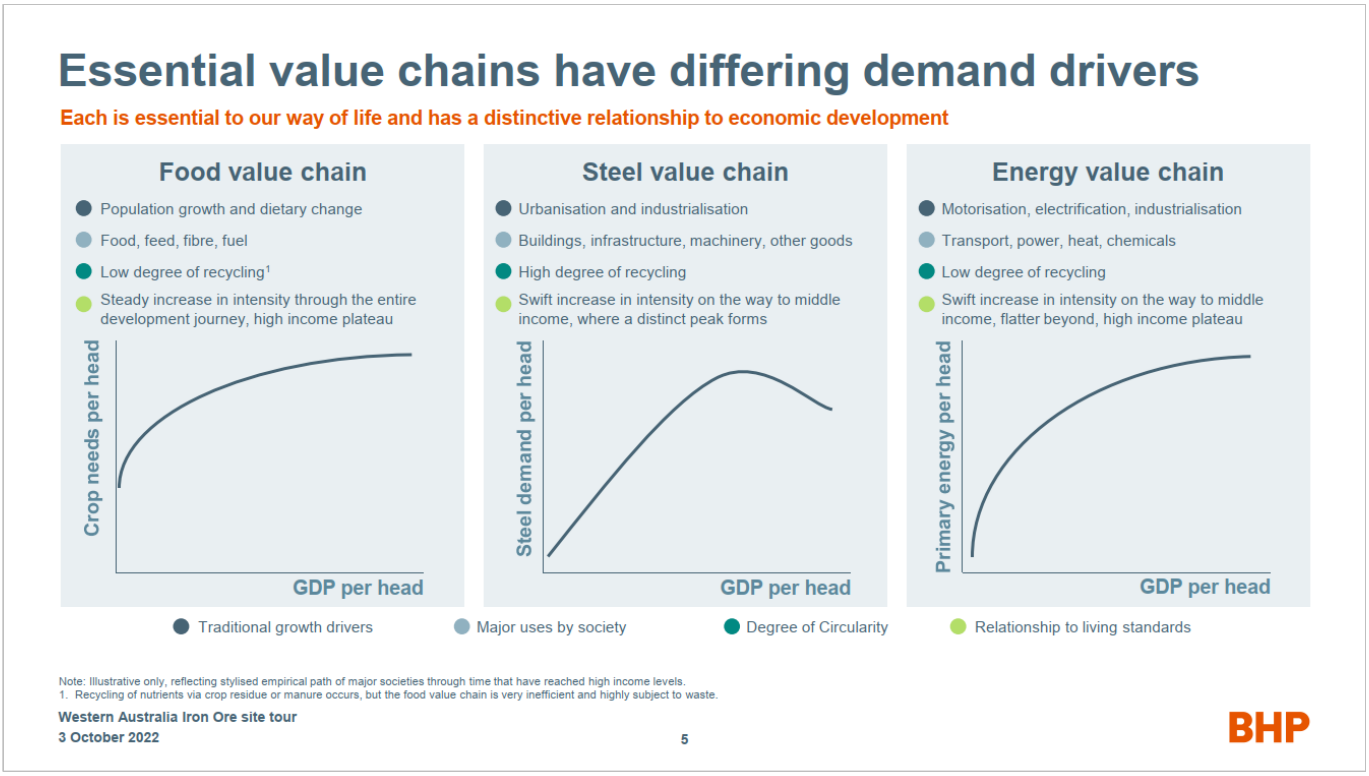
This slide encapsulates all of that.

As we go deeper into the narrative, note that the regional slides will feature 3 cases rather than 5.

This is for reasons of both simplicity and false precision – as the 1.5 degree and climate crisis scenarios are designed as top-down global simulations, we feel that they are less useful for assessing granular regional detail than bottom-up cases like Deep Green and the scenarios for 2 and 3 degrees.

Other than that, expect to see this style of data presentation repeated throughout the discussion.

The long term question for the iron ore industry is how, and where, all of that steel will ultimately be produced.



Before we get to that though, let’s take a look at how the steel value chain interacts with the broader economic development process.

These schematic charts depict arguably the three most important value chains in our society today and their relationship to rising living standards: food on the left, primary energy on the right and steel in the middle[1].

Each is absolutely essential to our way of life, and each has a distinctive relationship to economic development.

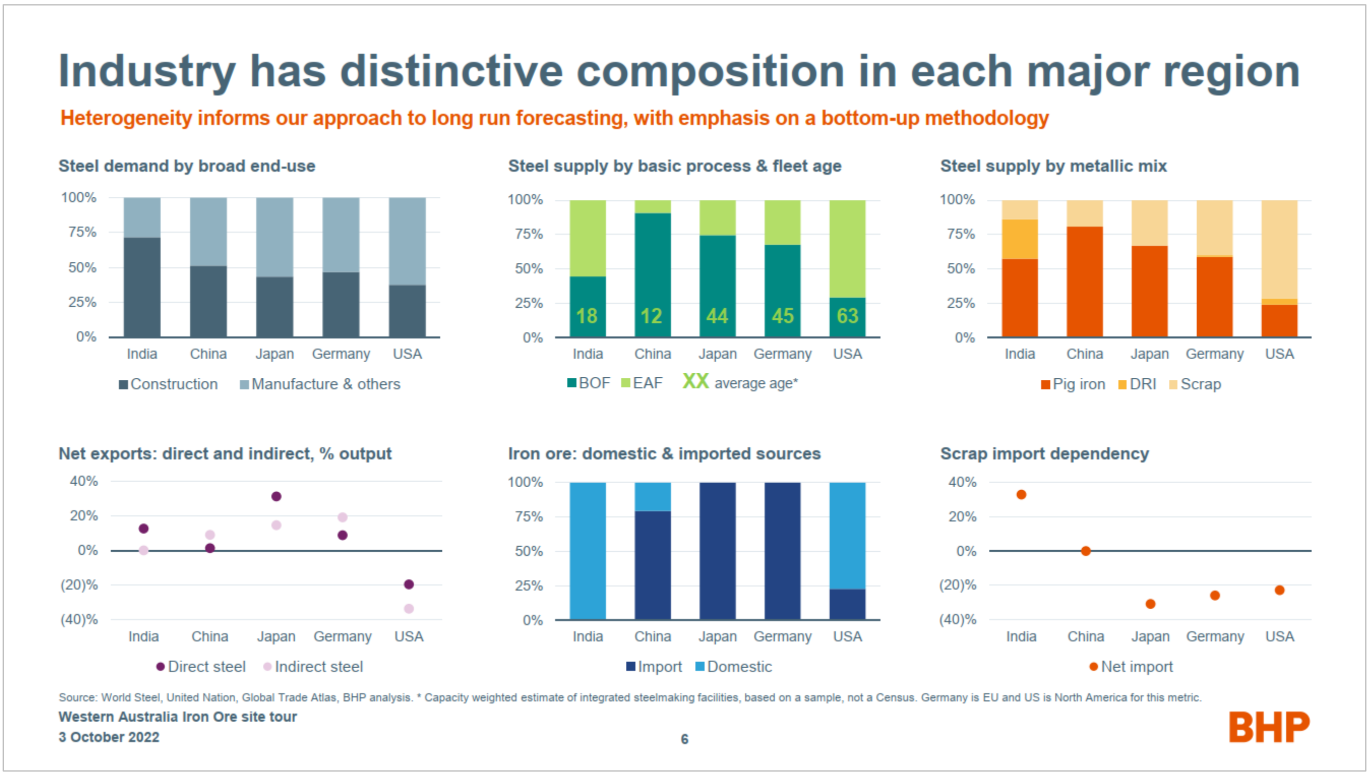
In contrast to food and primary energy, which tend to increase in per capita terms throughout the journey to high income status, steel use per head tends to follow an upside down U shape over the course of the development journey, with the peak or plateau at the national level occurring around middle income.

Early in the national development life cycle, the major use of steel is in construction, which is closely associated with the process of urbanisation.

As an economy develops, manufacturing becomes a more influential user, as the emphasis of the capital stock buildout shifts from dwellings and infrastructure to transport machinery, consumer and capital goods.

At industrial maturity, manufacturing becomes dominant.

[1] Critical minerals like copper obviously deserve a place in this discussion of “most essential”. The reason there is not a fourth panel for copper is that its relationship to traditional demand drivers is sufficiently similar to steel that including it would not add substantially to the overall discussion.



If you direct your eyes to the top left hand panel of this chart, you will see that wealthy countries like the US, Japan and Germany use the majority of their steel in manufacturing rather than construction, somewhere in the range of 60/40 to 70/30.

In India, where living standards are around one-tenth of those in the US, 70% of steel goes into construction.

In China, the ratio has been close to 50/50 in recent years.

Surveying the other panels, you will see each region has a distinctive combination of characteristics, reflecting local demand conditions, diverse indigenous feedstock availability, and different capabilities and attitudes towards the trade in scrap and the trade in direct and indirect steel products.

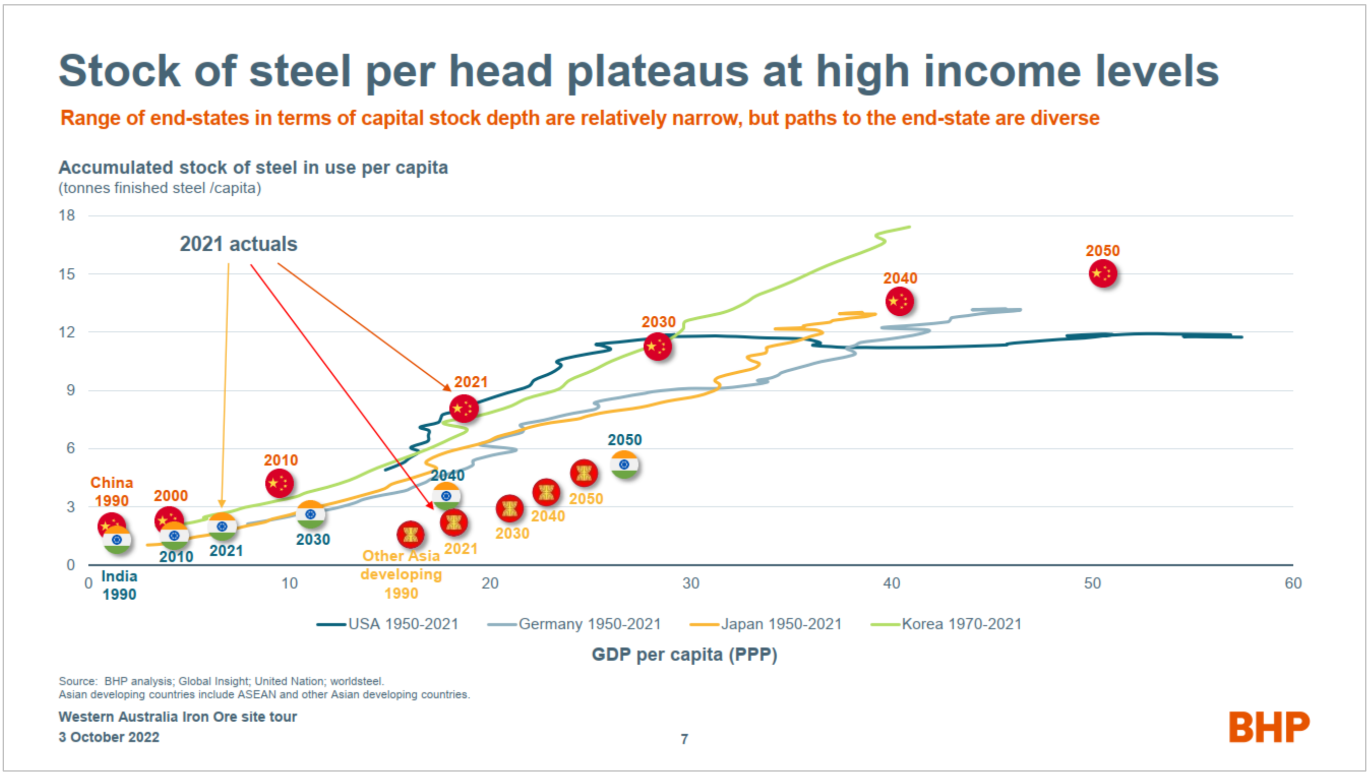
This heterogeneity informs our long run forecasting, which emphasizes a bottom-up, regionally idiosyncratic approach.

Some interesting kernels of information from this chart include the fact that:

- Japan is the most exposed to direct exports of steel
- Germany is most exposed to indirect exports (in other words, steel embodied in other products, like an excavator).
- As a proportion of total production, China's direct trade position in steel is lower than Japan's, Germany's and India's.
- India is, by far, the most reliant of the major producers on DRI feedstock and on imports of scrap.
- The US is by far the most reliant on domestic scrap for its own production, while still maintaining a sizeable net export position in the feedstock.

Iron ore trade exposures are pretty close to binary for 4 of the 5 – India and the US/North America are close to self-sufficient, while Japan and Germany are fully reliant on imports.

The two measures where the Chinese system is a clear outlier are the interdependent observations on blast furnace (BF) and pig iron (PI) share.



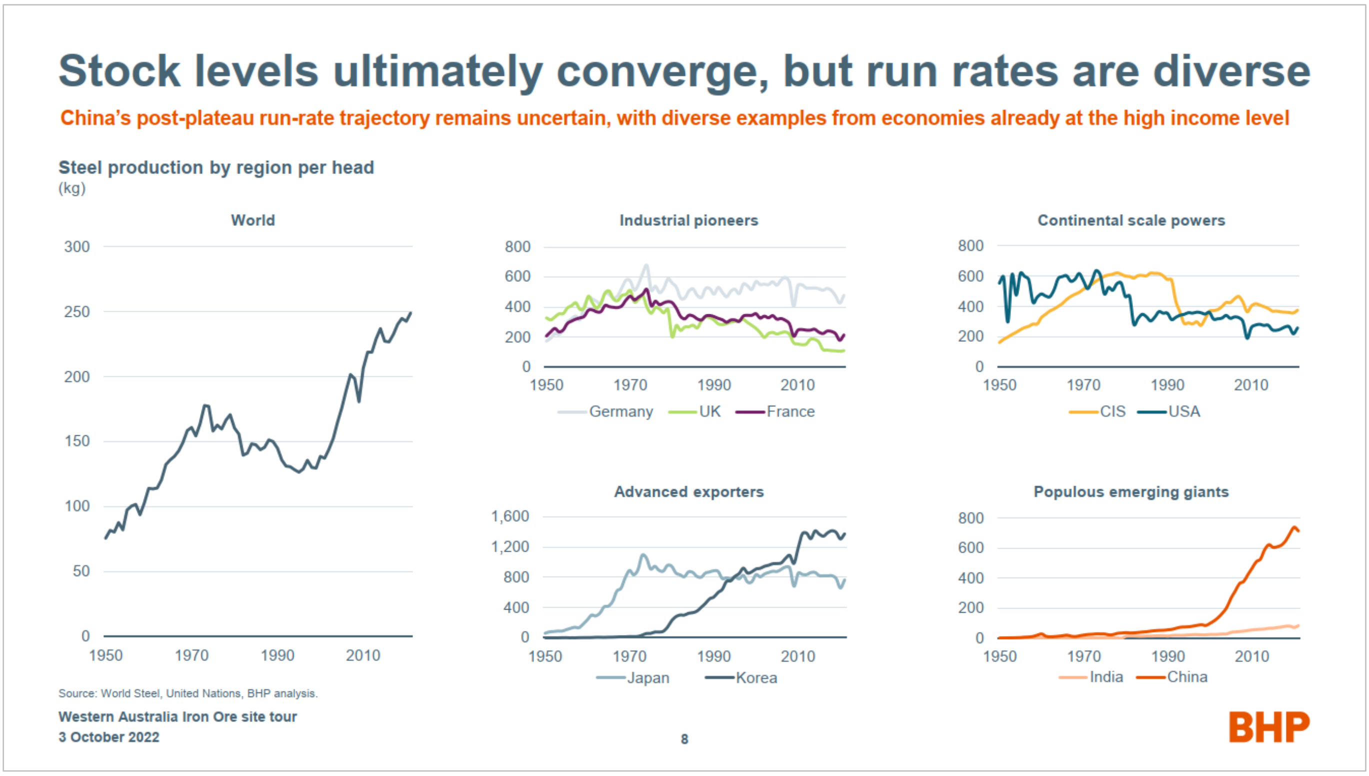
So let me now turn to China.

China’s accumulated stock of steel in use sits close to 8 tonnes per capita today. We firmly believe, that by mid–century, this will almost double.

China’s current stock is well below the US level of around 12 tonnes per capita. While Germany, South Korea, and Japan, have even higher stocks than the US.

You can see that history, and our forecasts for China, India and SE Asia, on this slide.

We estimate that by 2050, China’s growing stock will create a flow of end–of–life scrap sufficient to enable a doubling of China’s current scrap–to–steel ratio of around 22%.



The exact trajectory of annual production run–rates in China that will achieve the future doubling of the stock is uncertain.

On this slide, we switch from stock levels to annual run rates, or "flows".

You can see the smooth, multi-decade waves of global steel intensity per capita on the left, and a diverse set of individual regional pathways in the remaining panels.

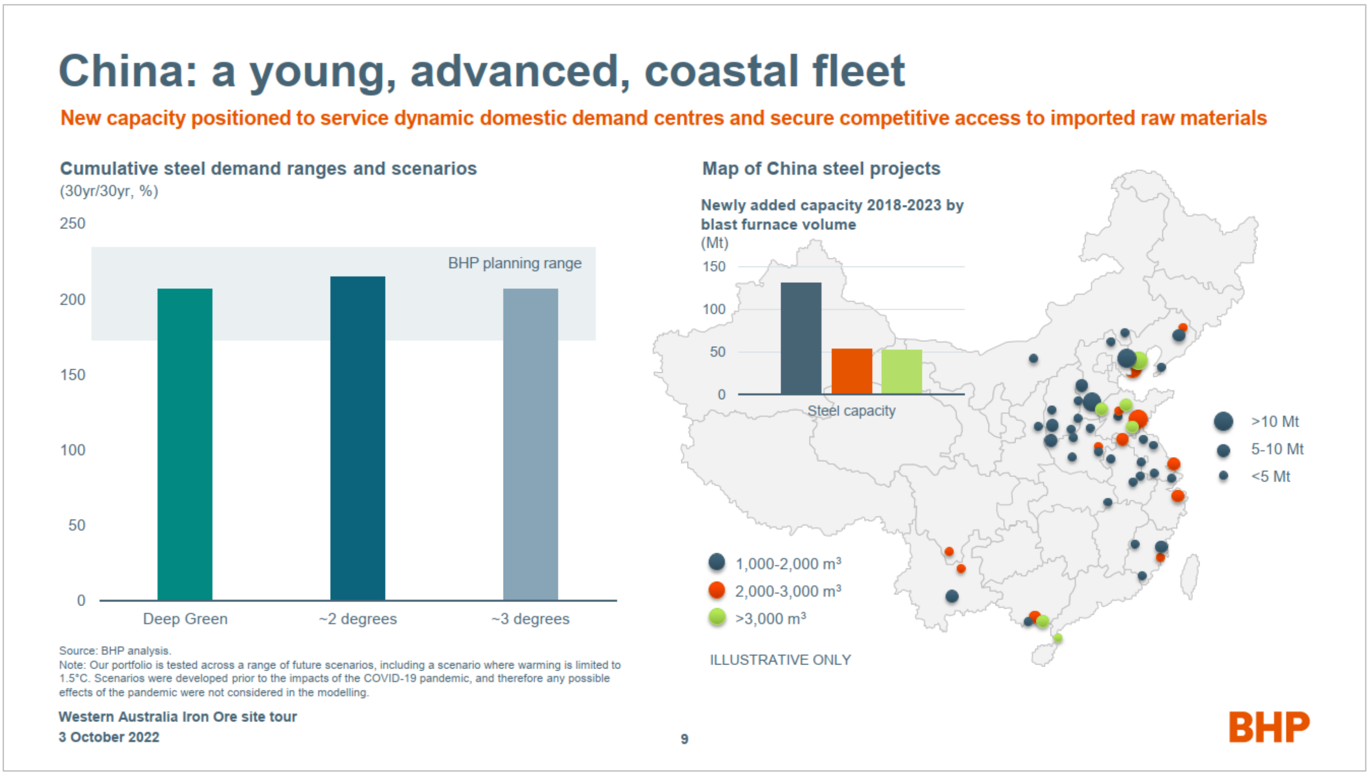
Our base case remains that Chinese steel production is in a plateau phase in the current half decade, between 1 and 1.1 billion tonnes per annum (or between 700 and 770 kgs per head).

The veracity of the plateau concept has been aided by the fact China is on track for a fourth straight year within the above range.

It is also underscored by the authorities pursuing zero-growth in 2021 and a net reduction in total output in 2022.

Probabilistically, the 1.065 Bt produced in 2020 therefore has a better than even chance of being the literal peak, once all is said and done.

That observation is notwithstanding the fact that current capacity has demonstrated the ability to produce monthly run-rates that have comfortably exceeded 1.2 Btpa.

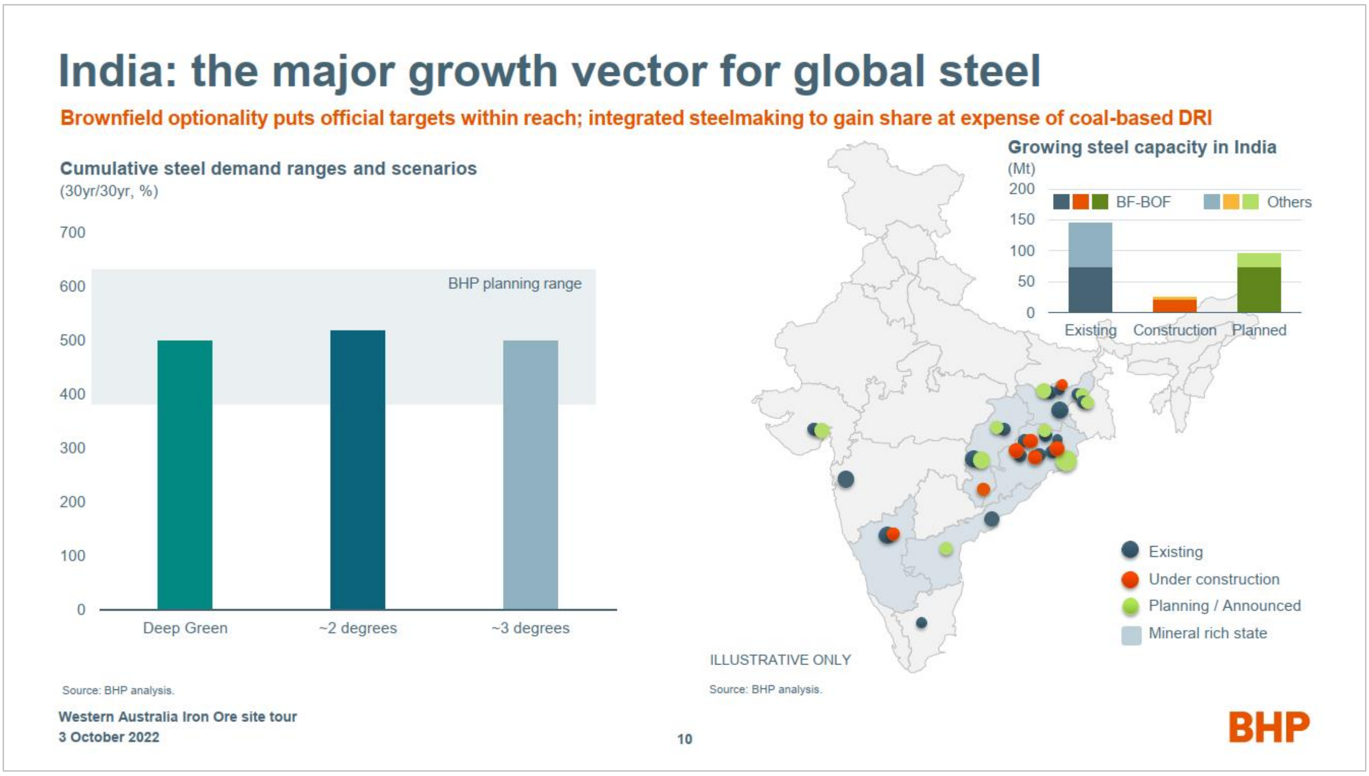


Beyond increasing scrap availability, the decarbonisation choices of Chinese steel mills will be determined by the age of their integrated steel making facilities, the policy framework they are presented with, developments in the external environment impacting upon Chinese competitiveness, and the rate at which transitional and alternative steel making technologies develop at home and abroad.

China of course has by far the youngest fleet among the major producing regions, at just 11-13 years.

Capacity has been turning over quite rapidly in the last 5 years, under the auspices of the SSR and the capacity swap scheme.

The clear trends have been to build larger more efficient furnaces, that are closer to both domestic demand centres and imported raw materials supply on the coast.



Turning to India now, we hold a constructive view of India's steel demand in the coming decades, based on highly prospective secular fundamentals.

To cut a long story short, we see a pathway to India expanding steel production four-fold by 2050 (using 100Mt in 2020 as a base). Starting with demographics, the total population is expected to increase from around 1.4 billion today to around 1.7 billion in 2050. We expect roughly 400 million Indians will migrate from rural to urban areas in the next thirty years. This will take the urban share from around one-third to around one-half. That segment of the urbanisation arc is the sweet spot for traditional commodity demand, and for steel in particular.

Alongside these monumental demographic and spatial changes – 3 of the world's 5 largest cities are expected to be in India in 2050, up from just 1 in 2010 – we expect living standards will rise from about 10% of US levels to about one-third by 2050 – something akin to the relative position of Thailand today. The combination of these secular forces will create enormous demand for affordable steel.

Of course you all know that India has promise – but historically you have banked that promise at your peril. So what gives us confidence in the long run outlook?

First of all, we have conducted an intense study of the government's ambitious target to more than double steel capacity to 300 Mt by 2030.

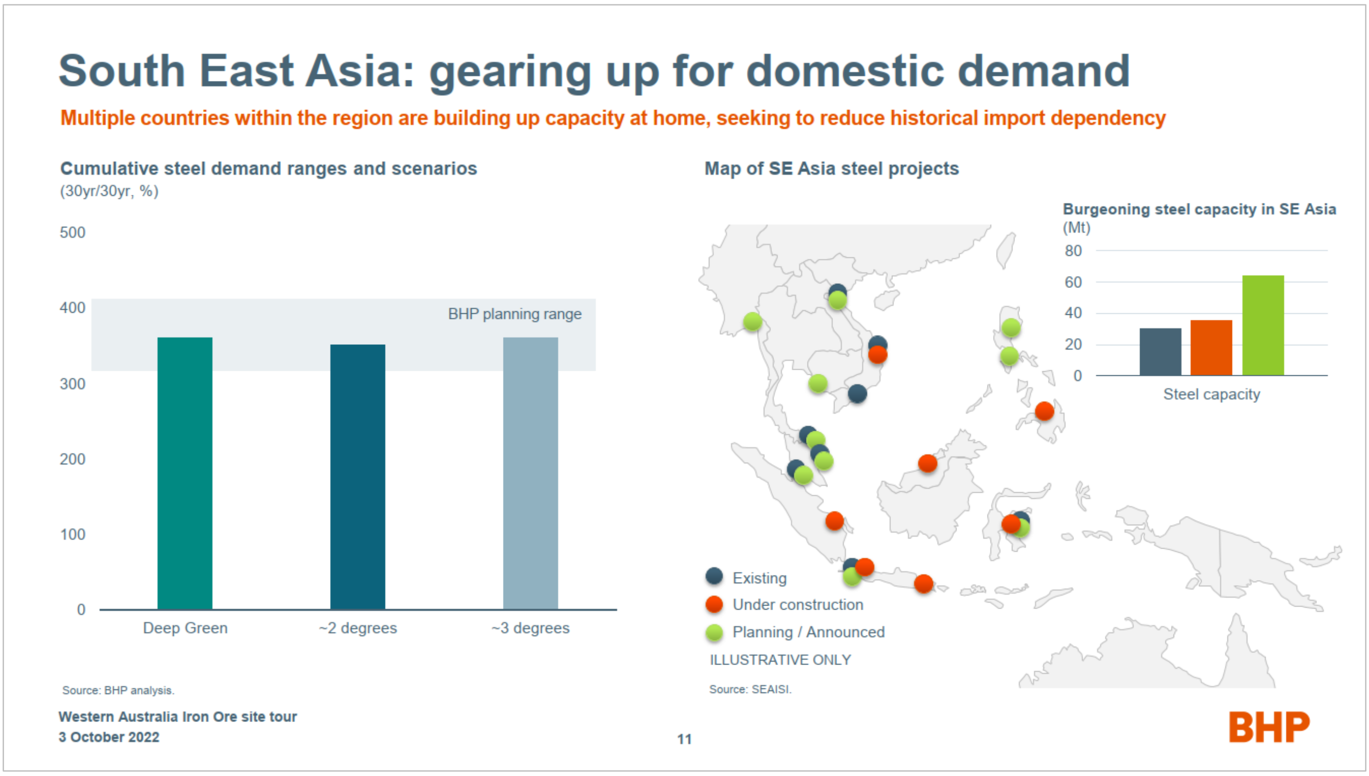
While we certainly discount the likelihood of hitting that precise target at that specific timing, our research shows that a plausible pathway to that interim milestone exists.

And I am not using the term interim flippantly. Some of you will have noted that my earlier statement of a 4-fold increase in production by 2050, (production, not capacity, which is how the government target is expressed), implies very firmly that yes, 300 Mt of capacity is far from the final destination: but it is an important stepping stone on a much longer journey.

You can see some of the potential expansions documented on this map, with an emphasis on co-location with the best of the domestic iron ore resource in the east-nor-east.

A final observation on this point: even with a 4-fold increase in production, India will still be moving along a steel stock in use schedule that is substantially lower than that of every major economy in our sample at equivalent levels of GDP per capita.

As I am fond of saying – both because it is true and also because it serves as a timely reminder and reality check for Euro or OECD centric views – the decarbonisation battle cannot be won in the OECD alone, but it can certainly be lost in the developing world. If I had to choose a single location where that statement holds most true, that choice would be India.

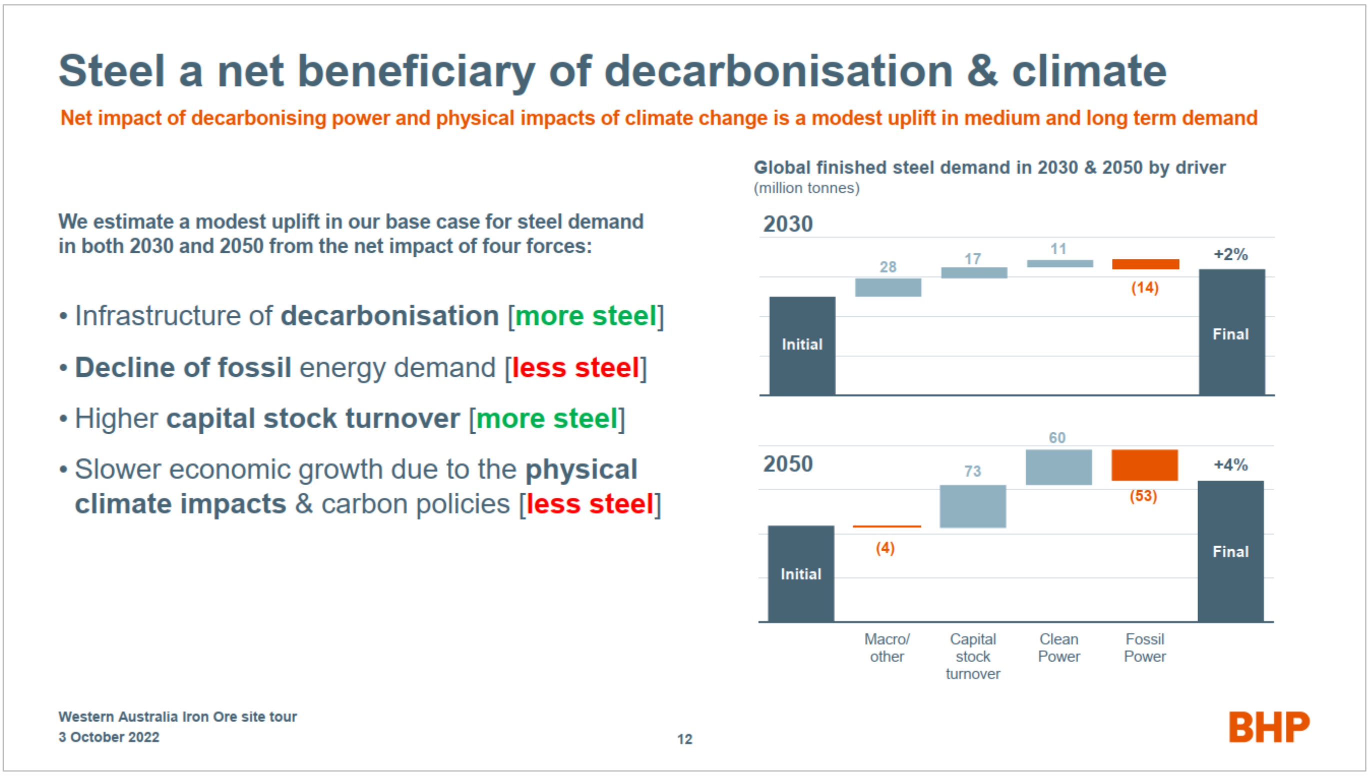


Somewhat lost between the two giants of China and India are the 700 million or so residents of South-East Asia, which is a dynamic and fast-growing region in its own right.

The region's steel requirements are close to 110 Mtpa today, and that is expected to triple by 2050.

Historically, the majority of the region's steel needs have been met by imports. But local production has been gaining share since the mid-2010s. And a mini-boom in blast furnace construction has kicked off, with a little under 40Mt of capacity currently under construction and over 60 Mt announced or in planning.

As you can see on this map the projects are region wide, not concentrated in a single hub or two, and many are also clearly dispersed within countries to service sub-national domestic demand.

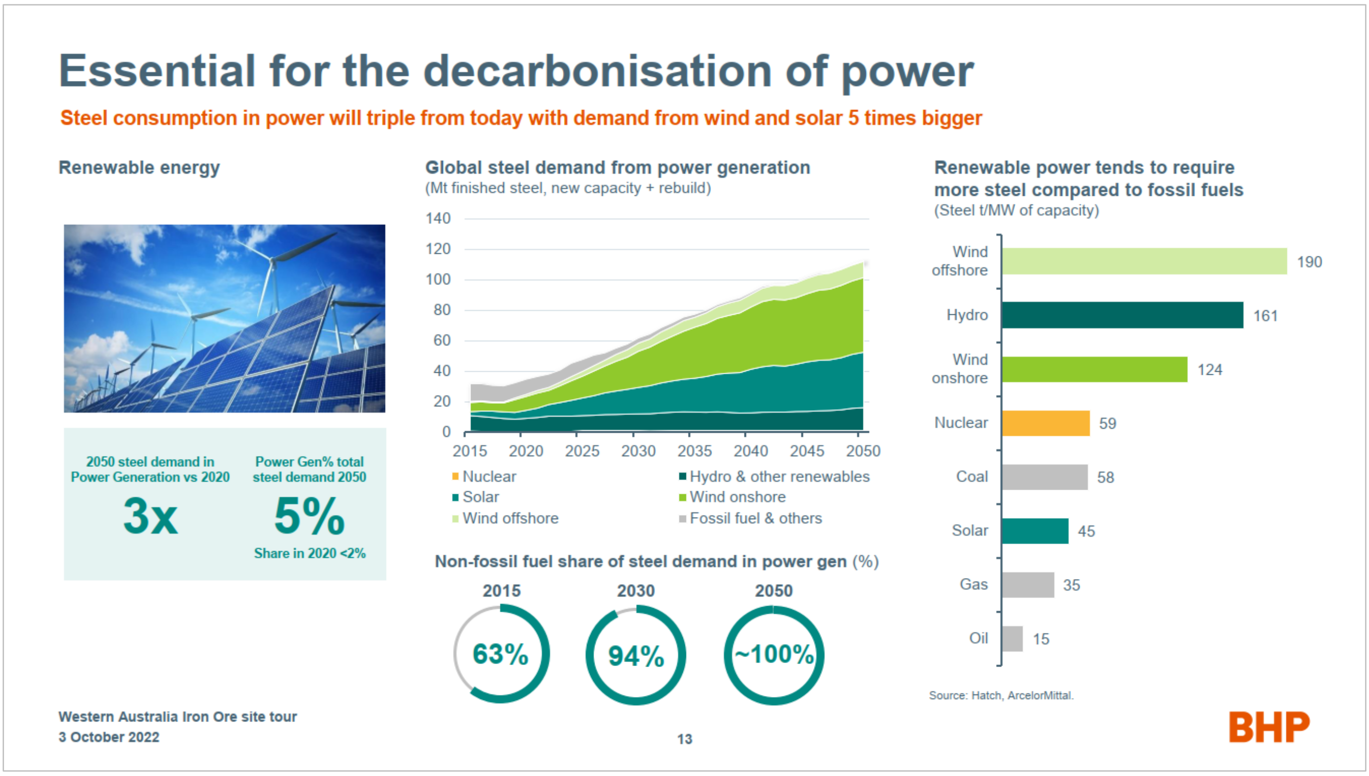


Having zoomed in at the regional level, it is now time to zoom out again. Let’s talk steel and climate change.

There are four main ways in which physical climate change, and efforts to address and forestall it, impact on the need for steel. They are listed on this slide.

As you can see on the right hand side of this chart, the net impact of these upward and downward forces is that steel demand is slightly higher under this combination of conditions than under a reference case that excludes them.

I will now focus on the first and third points in more detail.



Power generation currently provides less than 2% of global steel demand.

That is expected to triple by 2050, noting every percentage point increase in share in that year will equate to between 20 and 25 Mt – depending upon what you assume for other sectors.

The decarbonisation of power will be dominated by onshore wind and solar PV, with complementary roles to be played by offshore wind, hydro and nuclear energy.

Where pure steel intensity per mega watt of capacity is concerned, wind and hydro power are the clear standouts.

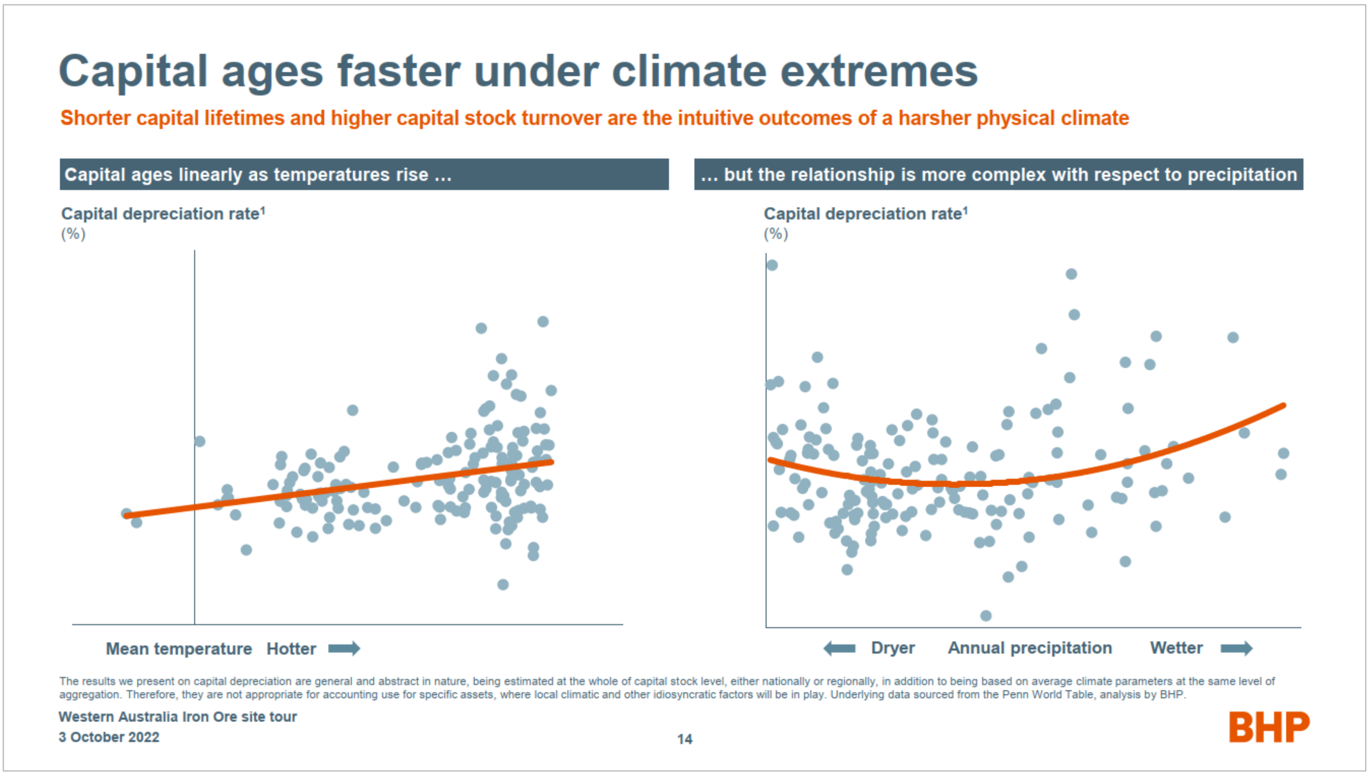
Offshore wind capacity requires 190 tonnes of steel per MW, and onshore capacity requires 124 tonnes.

Hydro capacity requires 161 tonnes.

Solar is less steel intensive, at 45 tonnes per MW,

But the sheer scale of the projected solar buildout makes it the second largest contributor to the overall uplift in steel demand from power generation, behind only onshore wind.

Looking solely at steel demand from the wind and solar segment, it is expected to increase five-fold from today to 2050.



Beyond building out the infrastructure of the energy transition, physical climate change will also have an impact on the need for steel.

We have made an interesting discovery in our investigations of climate change in all its aspects: an empirical relationship between climate parameters and the rate at which capital ages (or “depreciates”).

Capital lifetimes and replacement cycles matter a great deal in long term commodity demand forecasting.

Our results imply, intuitively, that physical capital ages more quickly in less-temperate climates: those that are very hot, very dry or very wet, and especially where either precipitation extreme is mixed with heat.

In both of these charts, we have plotted capital depreciation rates on the vertical axis.

In the left hand panel you can see the simple, upward sloping linear relationship between depreciation and temperature.

In the right hand chart, we have precipitation rates on the horizontal. The relationship is more complex.

As you can see, rather than being linear, the fitted curved is a flattish U-shape or a “smile” as such curves are appropriately dubbed in finance theory.

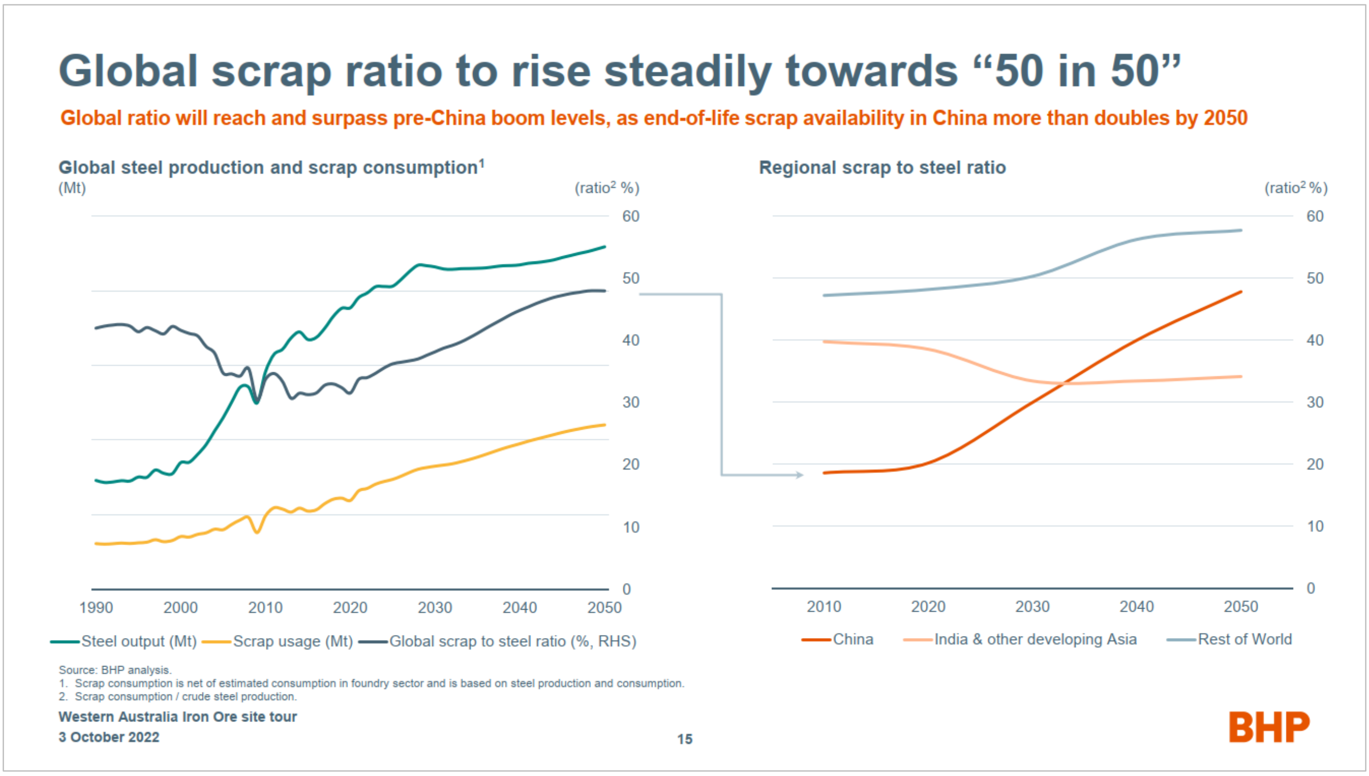
We have decided to name this new curve after the Sumerian god of rain, Ishkur. >>> let me present “Ishkur’s smile”.

In practical terms for steel, these relationships imply that as the climate warms and precipitation tends towards extremes (i.e. wet areas get wetter and dry areas get dryer), additional capital stock will need to be replaced each year versus the reference case, pushing the fixed investment needs of society upwards.

That implies that the world is likely to become more materials intensive as physical climate change unfolds, all else equal. On the basis of this research, we have shortened capital lifetime assumptions in our demand models, which has two impacts.

1 it brings forward replacement demand, which front-loads the need for steel versus prior cases. This effect is worth 73 Mt in 2050 in the ~2 degree scenario – about the same as adding another South Korea to the market.

2 it also brings forward scrap availability, which partially discounts the flow-through to iron ore.

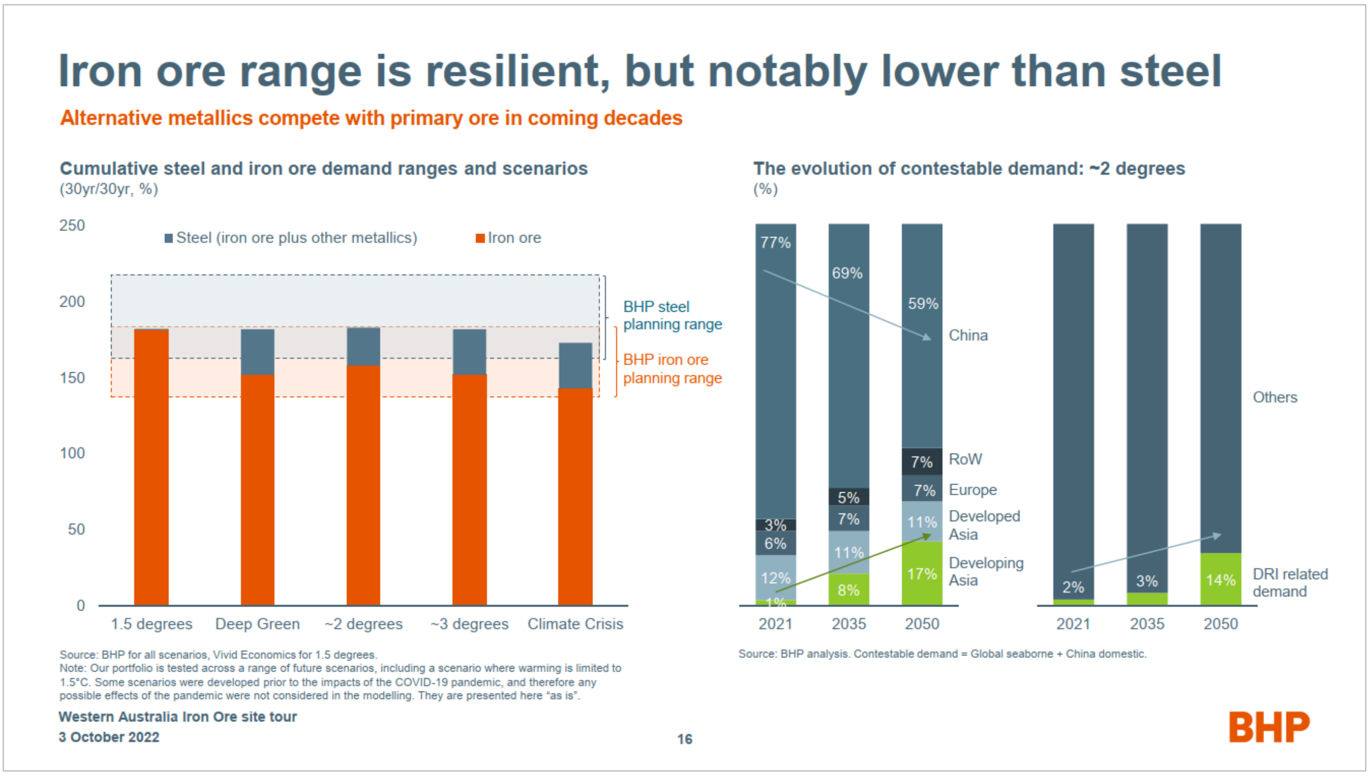


A final word on capital stock turnover and scrap.

In high income regions that have reached the point where the stock of steel in use levels off, the replacement of capital stock becomes an important driver of the flow of steel demand, just as the retirement of the old stock influences the flow of scrap.

Replacement demand is also a key reason why steel demand in high income regions does not fall all the way back to the level of low income regions even decades beyond their obvious peaks.

When we talk about an upside-down U shape for steel output per head, In the form of the Kuznets Curve for Steel that I presented in the schematic diagrams at the outset – what we really mean is that steel demand per capita for an industrially mature economy looks like a question mark sitting on its side.



This slide reproduces the same information for steel you saw earlier, but also superimposes the outcomes for iron ore.

Here you can see that flexing technology and policy levers across the various scenarios brings greater differentiation for iron ore, while lowering the entire planning range vis-à-vis steel, consistent with an anticipated increase in scrap.

On the right-hand side of the chart, we also show the projected increase in DRI usage, and we have gone into the changing regional composition of demand a little further, highlighting rising shares for developing Asia and a material decline in the share for China, notwithstanding the fact it remains more than three times the size of the second largest region.

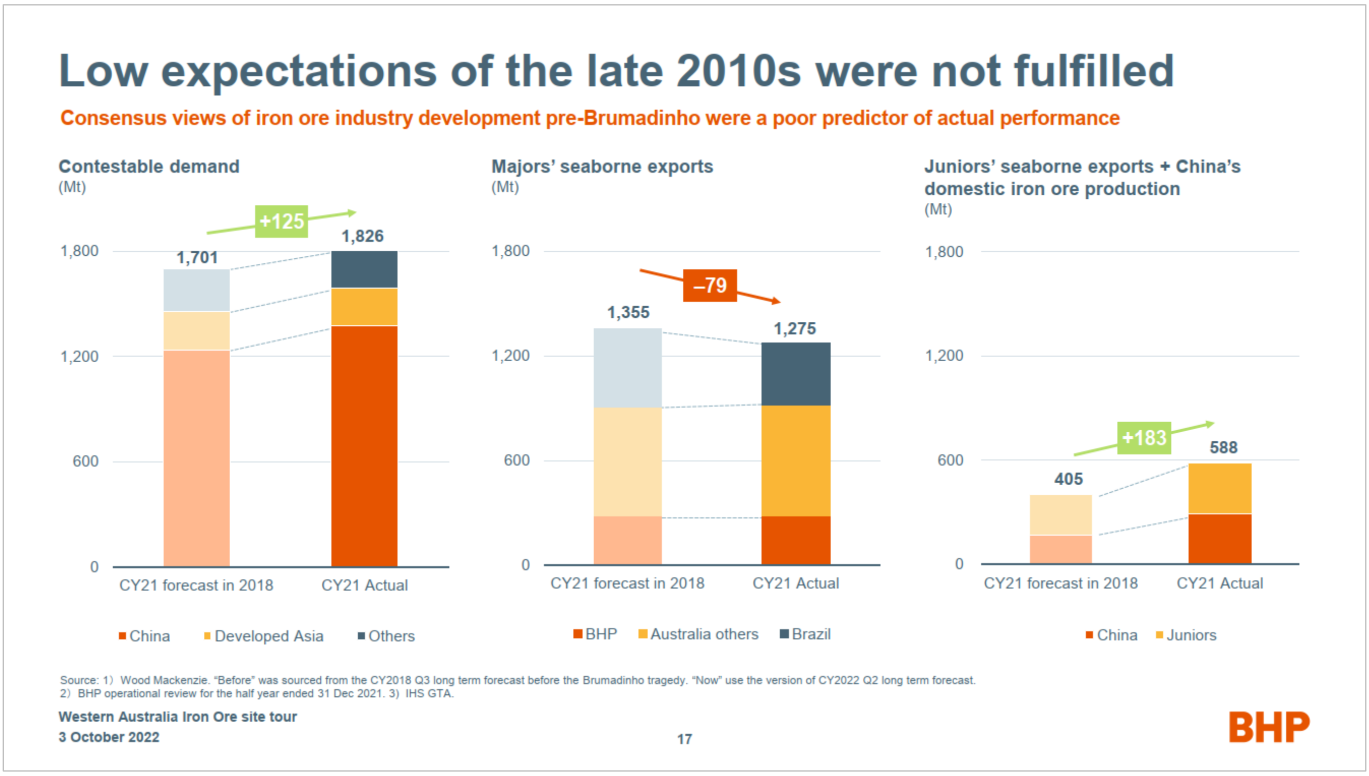
The numbers in the chart are our own projections.

For another view of this, Wood Mackenzie projects 170 Mt of import demand from Developing Asia in 2050, roughly 130 Mt higher than today, and a little over 600 Mt of ore consumption, up from a little less than 250 Mt today.

On the import side, in 2050, they project roughly 50 Mt will go to India, 50 to Indonesia and 60 to Vietnam. This growth is an important offset for the projected decline in China.

In my mind, resilient is the word that best describes this outlook for iron ore demand.

This underscores the fact that we continue to see this industry as an attractive one for BHP.



In recent history of course, iron ore has been a truly spectacular industry to be a part of. However, just four years ago, expectations were low. In the midst of the US-China trade war, the consensus was that demand would be modest, low cost seaborne supply would increase, higher cost supply would be progressively squeezed out, the cost curve would flatten and prices would soften.

In reality, the opposite has happened on every score.

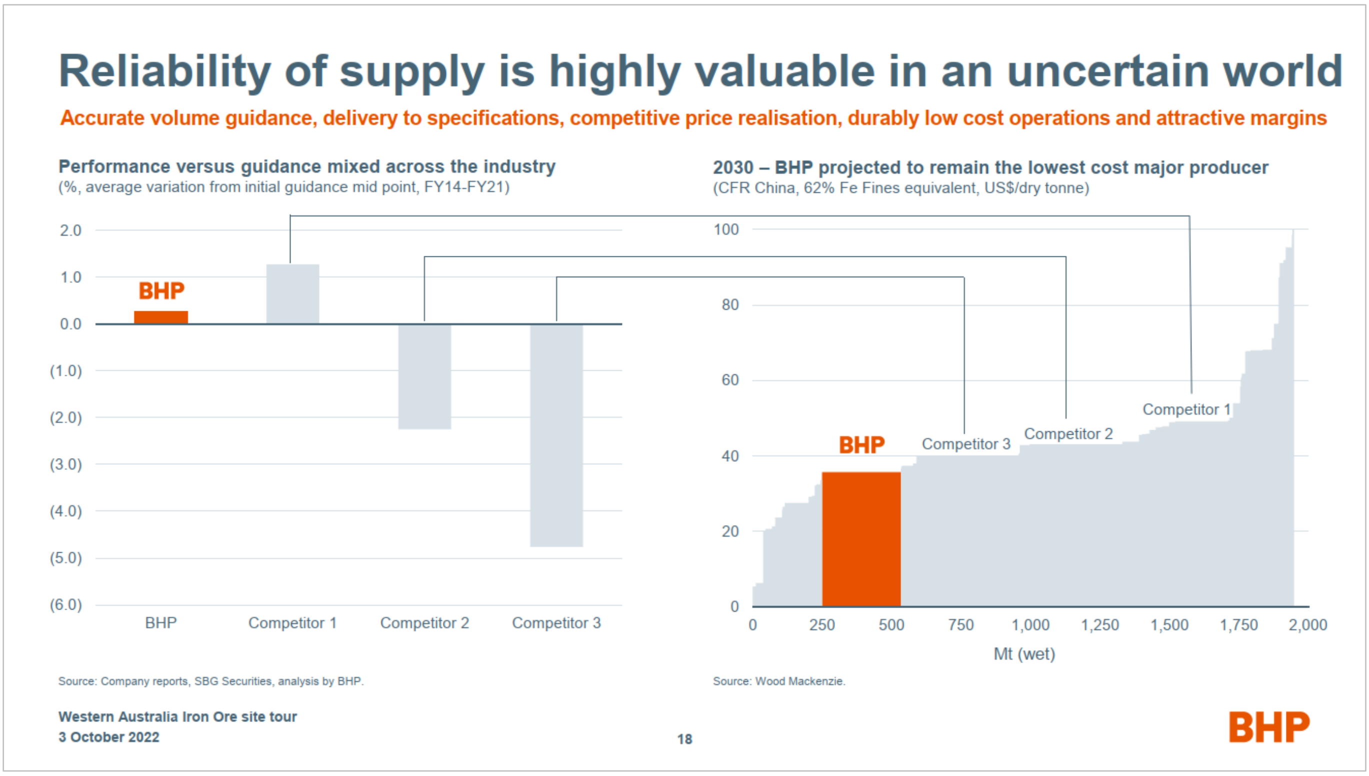
In terms of our own views, we agreed with much of the stylised Consensus position at this time, with the exception of demand, where I would argue we have been consistently more positive than most since the mid-2010s – reflecting in large part our long held views on the timing and level of China's plateau.

Using Wood Mackenzie's forecasts as a proxy for market consensus, we have assembled expectations for the state of the industry in CY2021 from the vantage point of 2018. We have compared that the actual outcomes. The results may surprise you.

Contestable demand is +125 Mt higher than was expected. Major seaborne producers have collectively exported 79 Mt less than expected. And rather than being squeezed out, higher cost producers (China domestic and junior seaborne operators) have increased production by 183 Mt.

And you don't need me to tell you what has happened to price. We hit a new record in 2021, and cost support is currently sitting in the $80-100 range in 62% CFR terms. The price has bounced off this level more than once since Chinese steel curbs were introduced a little over a year ago, which is an important buttress to the desktop view of where real-time cost support might lie.

We also note that raw tonnages do not tell the full story on supply.



While an investor may define a reliable supplier as simply someone that delivers volume as guided, to a customer, reliable supply includes the additional criteria of delivery on time and to specifications.

On the simplest measure of reliability, the chart on the left shows the relative accuracy of volume guidance over the last decade.

As you can see, the record across the industry is mixed.

On the other aspects of reliability, those that matters most to the customer, the proportion of off-spec product has been rising of late, with mixed performance industry wide, which may be indicative of either geological or operational challenges – or both.

This has impacted upon absolute and relative realised pricing outcomes. If reliability is a distinctive trait (and the recent evidence implies that it is indeed distinctive) it is likely to be rewarded in price realisations – and that is something you saw very clearly in Brandon's competitive analysis.

Looking out a few years we consider the entry of new, higher-grade supply from the Simandou project to be a near-certainty, with first tonnes likely to come around the middle of the decade.

We also note the ambitions of the Chinese domestic iron ore industry to increase production materially, and the desire of some of our competitors to do the same.

We also need to square all of this with the many moving parts on the demand side, that we have just discussed.

And as Brandon has made clear, we are laser focussed on not just maintaining our position as the lowest cost major iron ore producer, but on extending our current lead and lifting our overall quality profile from its already competitive starting position.

Based on this projected 2030 cost curve from Wood Mackenzie, where the large flat sections represent the positions of the major producers, we are not alone in thinking that can be done.

We are conscious of the many supply side headwinds in this industry, some of which are common and uncontrollable for everyone, some are bespoke to specific regions or projects, and some are common but are areas where we feel we can continue to effectively differentiate ourselves through our ability to compete on both cost and quality at the asset, allied to world-class functional support to optimise both the inbound and outbound value chain.

Reliability of supply is highly valuable in an uncertain world (continued)

These factors include:

- The complexities of delivering major greenfield projects in challenging climate zones and/or new jurisdictions
- rising geological hurdles in mature basins,
- the rising incidence of extreme weather events,
- ever-escalating social value expectations, with heritage at the centre of that,
- uncertainty over medium-and-long term bulk shipping rates and what that means for the competitiveness of the major basins, and for new entrants
- differential sequences of mine depletion and hub productivity in the major basins
- uncertainty around the future of some swing supply into the seaborne trade
- the fundamental challenge of operational decarbonisation
- rising policy and geopolitical uncertainty globally
- the enduring theme of tight labour markets and pronounced skills shortages
- rising incidences globally of work stoppages in our industry and adjacent ones
- and everything we have learned about the fundamental fragility of supply chains under the stresses of recent years

Given these challenges, signalling an intent to grow and actually delivering on that intent in a timely and capital efficient way will not be a straightforward endeavour for all.

Knowing all this, and knowing the quality of our own resource, and our lengthy track record of both reliable operational performance and project delivery and understanding where the point of optimum operational efficiency for our basin may lie, there is a firm prima facie case to be studying the various paths to 330 now.

As I leave you with that basic thought, here is another point to add in terms of the delicate equation the supply side of the industry is attempting to solve: We also need to be very mindful that the quality requirements of our customers may become even more exacting as they embark on their decarbonisation journeys in earnest.

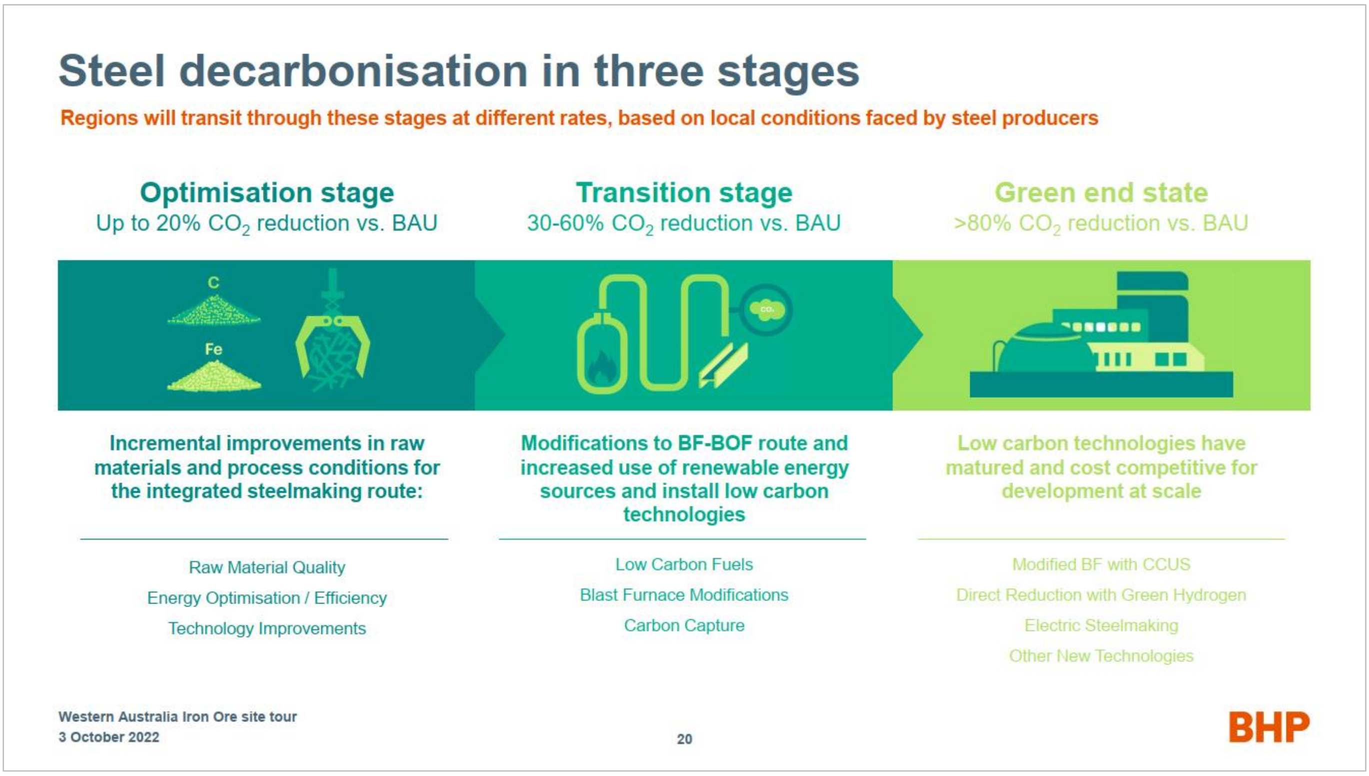
What might those journeys look like? Here is short teaser – after which Rod Dukino will replace me on stage.

Video: Pathways to decarbonisation: episode 5: the energy transition dilemma

Thanks Huw, and hello everyone.

My name is Rod Dukino, and I'm Vice President Marketing Sustainability and my remit includes our investments in steel decarbonisation

Today, I will provide an update on BHP's views on potential pathways towards steel decarbonisation. I will then look at the role BHP is playing in this journey, and the ways in which we believe low emissions steel production can be achieved using our Pilbara ore.



BHP’s three stage framework to low or no carbon steel production was first published in November 2020 remains relevant.

The majority of steel today is made via the BF route and the majority of steelmakers are undertaking actions to reduce carbon in the first phase, termed optimisation, through raw materials selection and best in class practices around gas and heat utilisation.

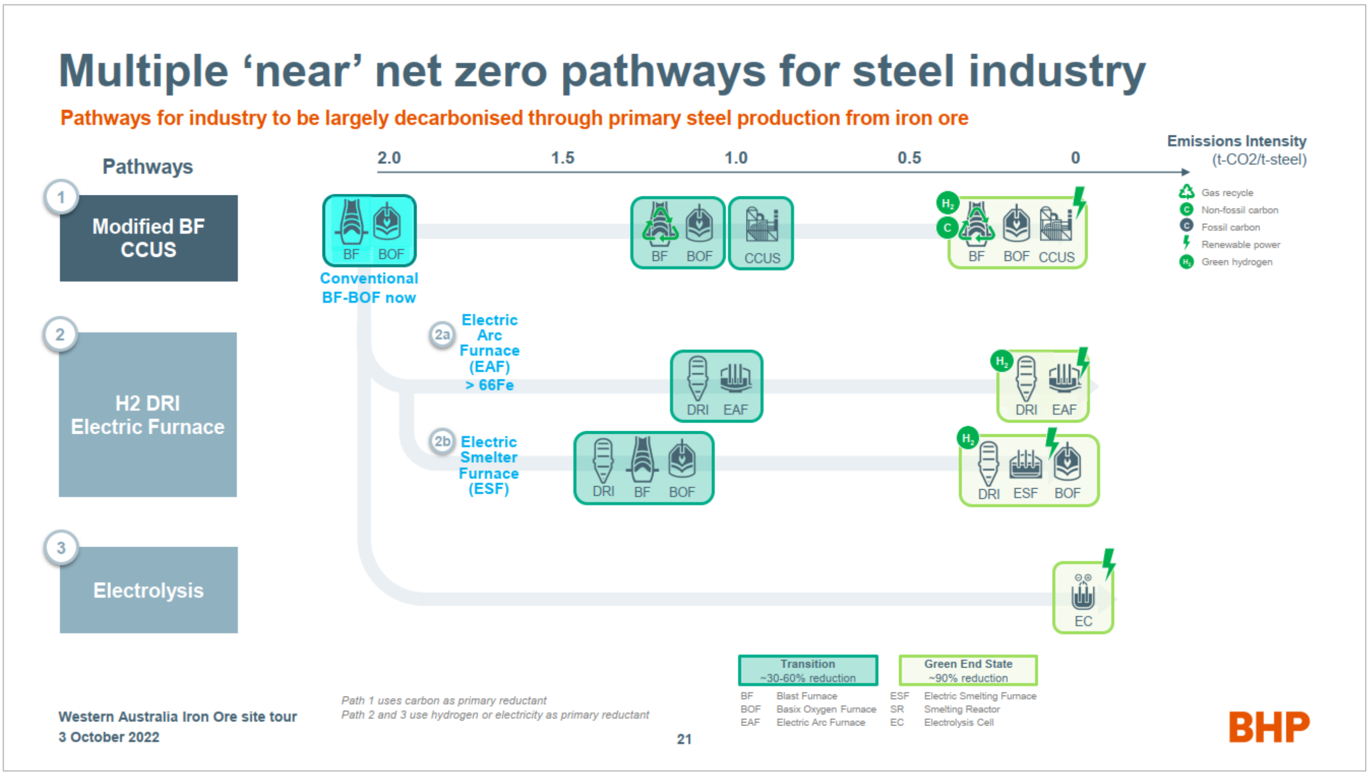
Market leaders are trialling projects related to the Transition stage, either through retrofitting existing BF based steelmaking with low carbon technologies or trialling Electric furnace technologies fed with either scrap or direct reduced iron (DRI).

The key levers in relation to the BF are replacing as much coke with hydrogen as possible, intelligently recycling waste gas streams and the use of CCUS to capture carbon dioxide from selected gas streams

The transition phase will play a necessary role in making a material reduction to carbon emissions in the medium-term, until the technology, economics and infrastructure required to support steelmaking in the ‘Green end state’ are viable

Moving from the transition to the Green end state, where steel can be produced at or near zero emissions, is primarily about the introduction of cost competitive renewable electricity and green hydrogen at scale

Let’s look in a bit more detail now at the pathways towards net zero for the steel industry.



Three pathways were developed through analysis of technology projects and discussions with customers, engineering and technology providers and the R&D sector.

1. decarbonisation of the BF route,
2. DRI/Electric furnace and
3. Electrolysis.

The diagram shows the carbon emissions intensity along the top axis, commencing at the conventional BF route today with about 2t carbon dioxide per ton of steel.

The intermediate steps in the darker green boxes represent the transition phase and the lighter green boxes to the right of the diagram represent the green end state for each pathway. As discussed, the key difference between the green end state and the transition phase is the introduction of green hydrogen and renewable power.

I would like to draw out 4 things from this slide:

Firstly, that irrespective of pathway, without economic supply of green hydrogen and power at scale the industry will struggle to reduce emissions below 50% of their levels today.

Secondly, through a combination of abatement levers it is possible for the BF route to approach near to a green state. All of these levers may not be viable in all regions but considerable reductions are possible.

Thirdly, in route 2, we have identified a new electric furnace technology call the Electric Smelter Furnace (ESF) that can replace the Electric Arc Furnace (EAF) and enables significantly better performance for Pilbara Iron Ores.

The Electric Arc Furnace or EAF was developed to melt scrap. Hence, when using direct reduced iron (DRI) in place of scrap it demands DRI made from very high-quality iron ore (>67%) and the DRI must have high levels of metallisation. We know first hand from the operation of our Pilbara HBI plant and associated beneficiation process that achieving both the quality required and degree of metallisation to ensure efficient operation of the EAF is challenging.

The ESF, on the other hand, operates efficiently with Pilbara ores and can manage lower levels of DRI metallisation. We have listed the ESF approach as route 2b.

We have drawn on our steelmaking past to identify this technology, which was used previously in the BHP portfolio and is still used at New Zealand steel today to smelt lower grade iron ore concentrate to produce titanium and pig iron. Bluescope steel recently referred to this technology in their investor briefing as a melter furnace – this the same technology I am referring to.

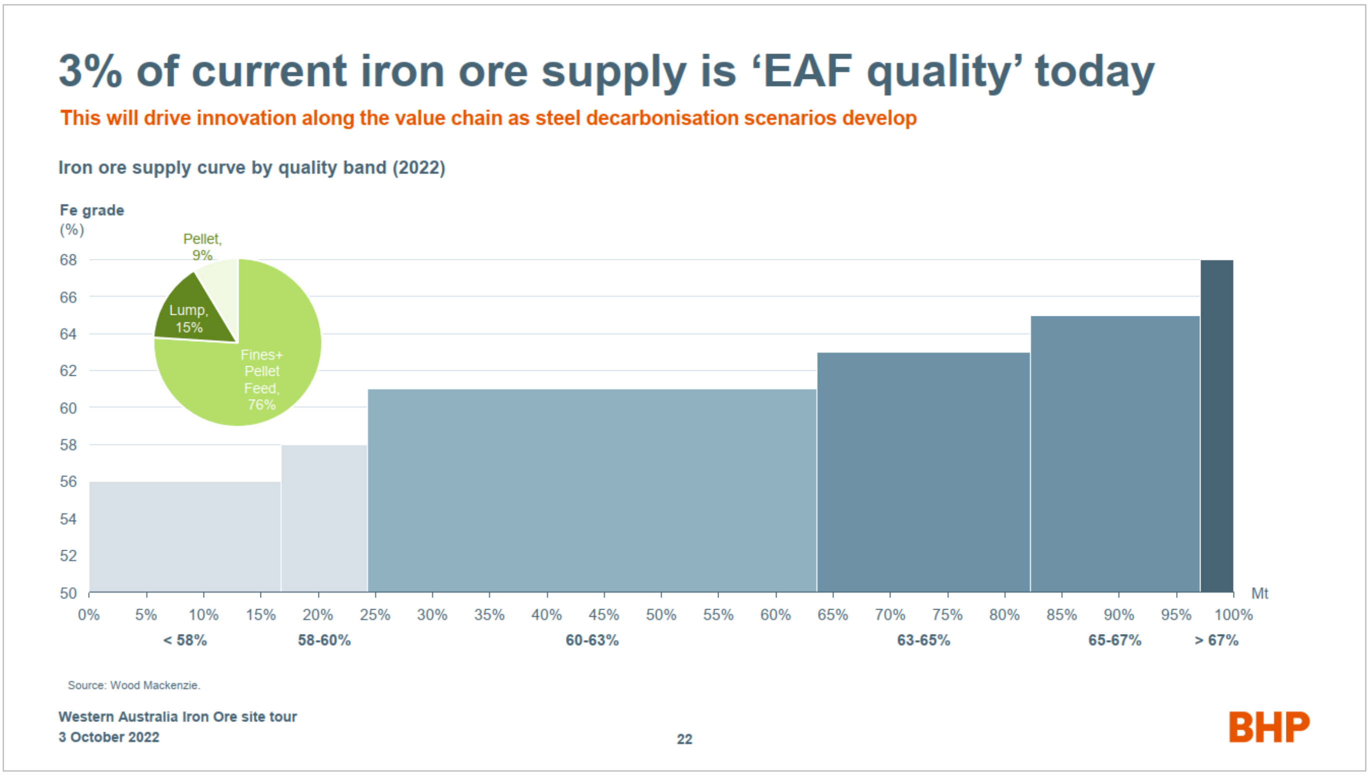
Multiple 'near' net zero pathways for steel industry (continued)

Using this knowledge, we worked with researchers at the University of Newcastle and technology providers like Hatch to firm up this concept… helping seed it with steel producers through our knowledge-share processes. Customers in Japan, Korea and EU are now looking seriously at this technology as part of their future DRI projects, and we have seen announced projects to build DRI ESF by Tata, ThyssenKrupp and POSCO, and observed a swing to consideration of ESF by other top steel mills.

Finally I would like to highlight is the third pathway on the slide, namely electrolysis. This is a promising technology that fully utilises renewable electricity for reduction and could demonstrate flexibility in use of ferrous raw materials. Laboratory scale trials have successfully produced steel using our iron ores.

The challenge here is the scale up and productivity required to make it equivalent to modern steel plants.

It is important to note that the costs associated with these abatement pathways are generally high and varying degrees of engineering or scientific technology development, and or carbon pricing will be required.

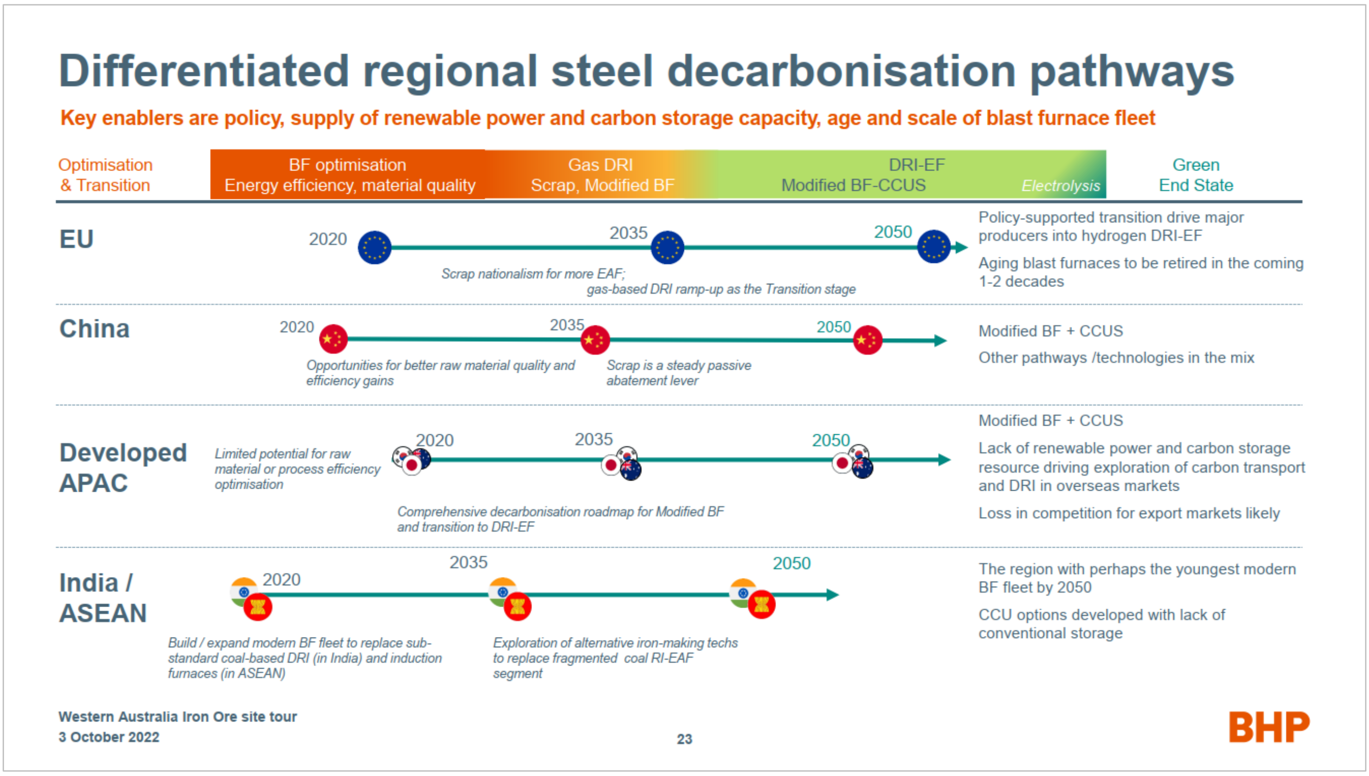


As mentioned by Huw, primary steel production remains key to delivering the steel demand forecast… that's after taking into account assumptions on scrap.

We can see from this WoodMac data that medium grade ores constitute a major part of the traded market and so called EAF quality iron ore, that is ore with Fe at least 67 per cent, constitutes only 3 per cent of the current market…

Whilst BHP is investing in novel beneficiation to improve performance, we know that the intimate association between a proportion of the gangue and the Fe minerals in Pilbara hematite-goethite iron ores presents significant challenges, particularly when driving for 67% grades.

Therefore, steelmaking technology changes like the ESF or Electrolysis are likely to play a role in supporting demand for Pilbara iron ores.



Efforts to decarbonise steel will proceed at different rates in different regions, based on availability of lower carbon raw feedstock (incl. scrap), the age of existing facilities, levels of policy support and demands for affordable steel.

Europe seems to be accelerating towards a H2 DRI Green End State through government funding and the application of carbon pricing – a so called carrot and stick approach. An ageing BF fleet supports this more rapid transition

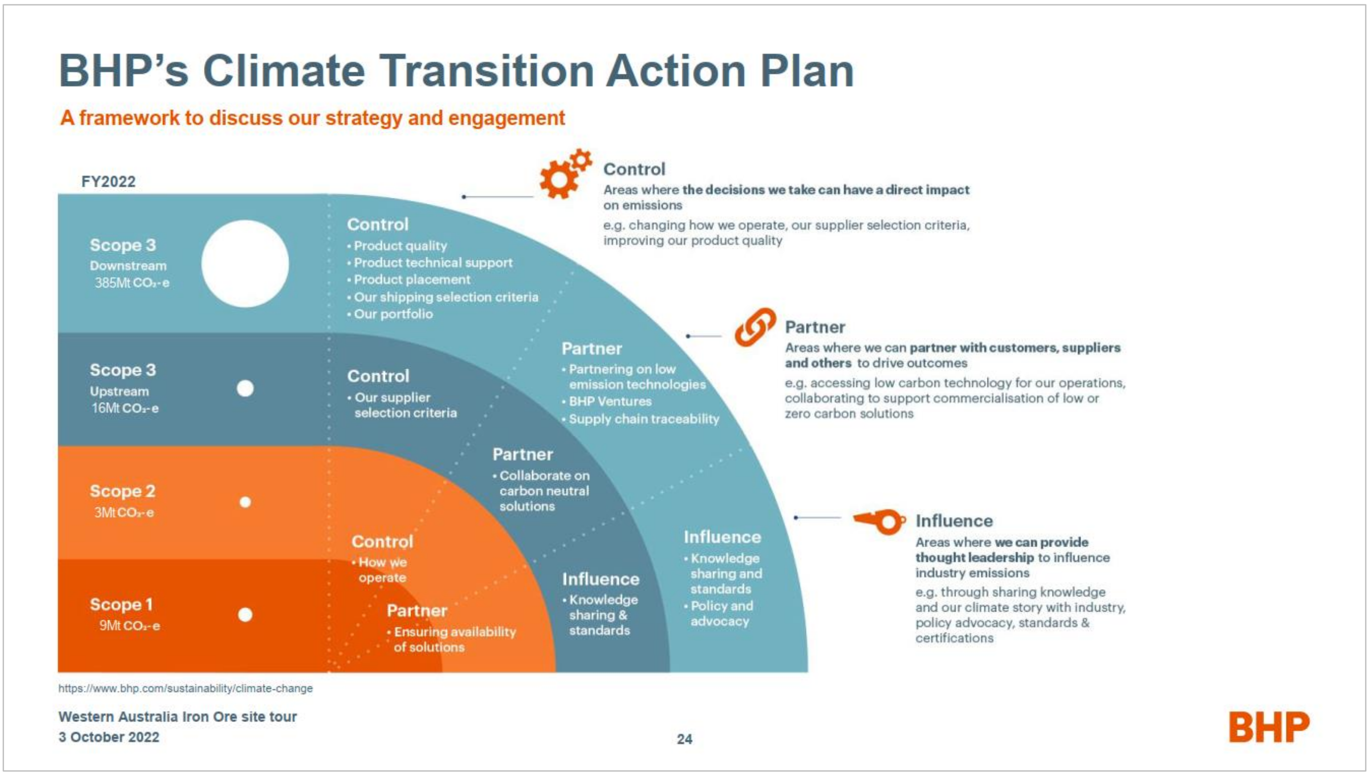
China has committed to a 2060 zero emissions target with larger SOE's committing to 2050… those same large SOE's state or infer continued use of the blast furnace as a major contributor supported by increased scrap usage, abatement technologies I discussed earlier and the development of DRI/Melter capacity from the 2030's.

China has storage options, massive BF production scale, alongside other heavy industry emitters like cement and chemicals – all supportive factors for the development of CCUS.

Japan/Korea is also focussed on decarbonisation of the BF route in the medium term whilst in parallel developing DRI/Electric furnace solutions. Unlike China these markets have limited conventional storage options for carbon dioxide and as such capture and utilisation is attractive.

India has set national target for 2070, setting the bar for steelmakers further out than other regions and as such may remain in the optimisation and transition phase for longer. India is still building new blast furnaces and will need to solve for the high emissions from the coal based sponge iron / EAF sector.

Let's look now, at what we are doing at BHP and our partnership approach to meet our Scope 3 emissions goals relating to steel production.



Our Climate Transition Action Plan… CTAP… outlines BHP's role and actions in helping the world achieve its decarbonisation ambitions. The CTAP framework lays out the Control, Partner, Influence framework for our approach

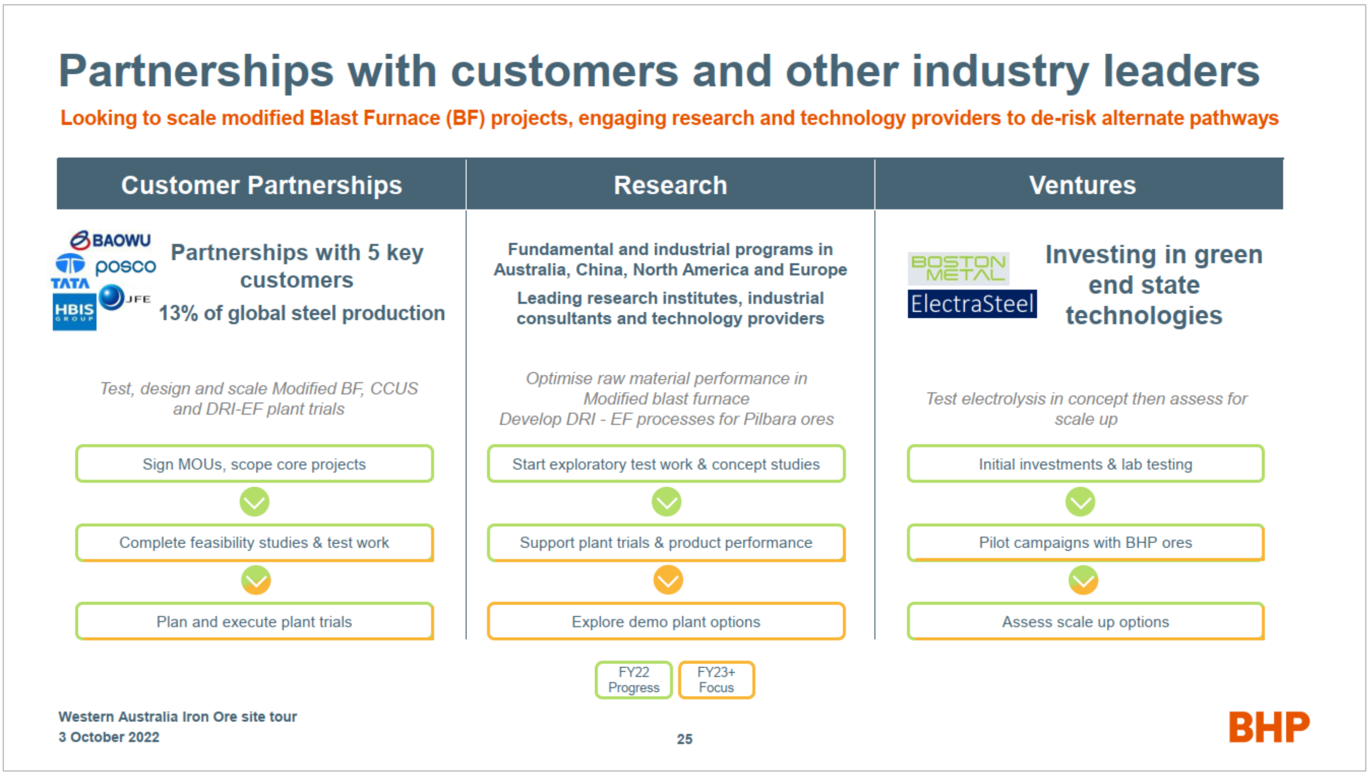
Partnerships, are the main engagement model we are using for our steel value chain and I will provide a detailed update on the following slide

We of control the products we sell, and who we sell to. As previously mentioned, we are evaluating conventional and novel beneficiation options for WAIO

We also advocate and influence through the work we do and we share as much of the knowledge we develop as possible. I've already mentioned our widespread engagements on the ESF. We share widely through customer partnerships, conferences and peer reviewed publications.

We are also advocating for transparency on emissions and use of consistent reporting standards. This helps set the base line for tracking improvements and provides visibility and confidence to value chain participants and external stakeholders.

Let's move to our partnerships.



Our customer partnerships are with the largest and most influential steel makers in Asia… representing 31 per cent and 25 per cent of our respective iron ore and met coal sales and 13.4 per cent of global steel production. We most recently signed an MOU with Tata Steel.

In addition to customers we have partnerships with OEM's, research institutes and with start-up companies via our Ventures investments.

Our partnerships cover all three decarbonisation pathways

To date our programs have primarily focussed on feasibility studies and research to support scale up opportunities.

- We currently have more than 30 active research projects in 5 countries
- Examples include work being done by COREM in Canada that helps our customers understand how to use our ores in pellets for BF or the DRI shaft furnace, and work at the University of Science and Technology Beijing on how iron ore lump behaves in a decarbonised BF.

Whilst our investment has been primarily focussed on lab scale testing we are starting to shift our focus to larger scale demonstrations. I'll talk briefly to a few examples from the optimisation and transition phase

- In terms of optimisation of the blast furnace route, in collaboration with two Chinese steelmills we have successfully conducted plant trials of displacing fossil carbon in sintering process with natural gas and increased lump utilisation in the blast furnace. The combined carbon reduction potential was 4-5Mtpa if realised across BHP's total iron ore sales.
- In the transition phase we are testing DRI process configurations and then working with customers like JFE and HBIS to trial at larger scale, with existing or future plants under construction
- Having helped define the DRI-ESF route for our Pilbara ore with our research partners over the last 12 months and now are working with technology providers such as Hatch, Outotec and Midrex to define the design and operational requirements required to support scale up.

Finally, our Ventures investment approach allows us to participate in early technologies and learn as they're developed:

Boston Metal and ElectraSteel are our two 'green end state' investments… and they have successfully produced electrolytic iron from our iron ores and they continue to impress us with the speed of scale up.

We see an opportunity for consortiums to accelerate project development and bring efficiency to investment. There are many willing parties who want to participate in steel decarbonisation projects - there is a case to pool resources and bring in financiers, to help make projects more effective.

Partnerships with customers and other industry leaders (continued)

To recap:

- There are multiple potential pathways to green end state steelmaking and our customers are primarily focussed on decarbonisation of the BF and DRI/Electric Furnace routes. Electrolysis is generating increasing interest. The mix of technologies will vary regionally and substantial technological development is required to support a green end state.
- BHP has identified the ESF as a preferred option for processing DRI into iron because it offers operational flexibility that supports a wider range of iron ore qualities including Pilbara ores. The technology has gained significant traction with customers in Europe and Asia.
- BHP continues to strategically partner with our customers, research providers and other stakeholders to demonstrate pathways to the green end state and is on track to deliver our decarbonisation goals.